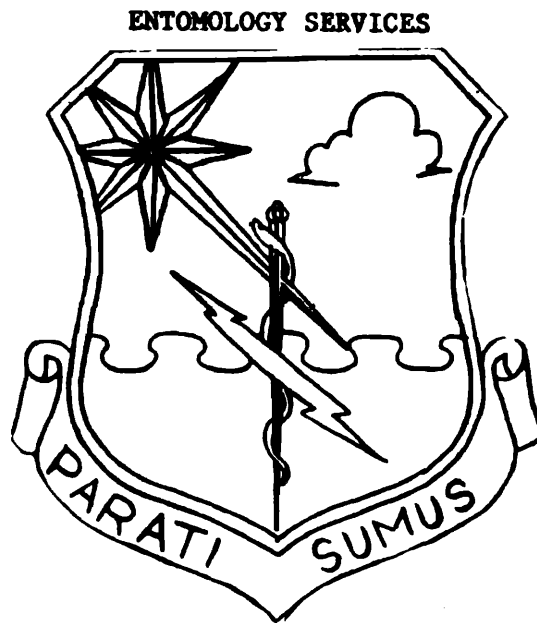


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Nowell, W.R. 09647-1.205

MOSQUITO SURVEY, ISLAND OF ROTA  
(MARIANA ISLANDS)



**1st MEDICAL SERVICE WING (PACAF)**  
**APO SAN FRANCISCO 96274**

July 1976

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**MOSQUITO SURVEY, ISLAND OF ROTA  
(MARIANA ISLANDS)**

**Wesley R. Nowell, Lt Colonel, USAF, BSC  
Chief, Entomology Services  
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APO San Francisco 96274**

**July 1976**

**APPROVED:**

  
**ROBERT R. SMITH, Colonel, USAF, MC  
Commander**

**1 MSEW-ENT-76-001**

## SUMMARY

On 9-16 May 1976, Lt Colonel Wesley R. Nowell and Master Sergeant Donald R. Sutton of the 1st Medical Service Wing, Clark Air Base, R.P., conducted an extensive survey of the mosquito population on the Island of Rota in the Trust Territory of the Pacific Islands. All sites surveyed yielded mosquitoes, and Rota was found to be heavily infested. A total of seven species was captured; three of these were new collection records for the Island. Mosquito control is desirable for the maintenance of morale and for medical and economic reasons. It can be accomplished on Rota through quarantine, technical surveillance, environmental management and public education. Chemicals are not recommended for other than localized treatment or emergency control requirements. This report provides a detailed description of the findings and mosquito data. Recommendations for island-wide mosquito control are included.

## 1. INTRODUCTION:

a. At the request of the Resident Commissioner's Representative, Rota, Mariana Islands District, Trust Territory of the Pacific Islands, Lt Colonel Wesley R. Nowell and Master Sergeant Donald R. Sutton, Entomology Services, HQ 1st Medical Service Wing (PACAF), reviewed the mosquito fauna on Rota Island on 9-16 May 1976. Objectives of the survey were to:

(1) Determine the number of mosquito species existing on the Island.

(2) Evaluate the new species introduction potential.

(3) Suggest procedures for the control of all mosquito populations on the Island.

b. This study was accomplished to provide assistance in preserving health in the Island's community. It was arranged through the auspices of the CINCPAC Representative for the Trust Territory of the Pacific Islands, and coordinated with the Resident Commissioner, Northern Mariana Islands District, Trust Territory of the Pacific Islands.

c. Cooperation, support and assistance from all offices and personnel contacted during this visit were outstanding and contributed to the successful accomplishment of the survey.

## 2. PERSONNEL CONTACTED:

Mr. Prudencio T. Manglona	Resident Commissioner's Representative Rota, Mariana Islands District, TTPI
Mr. Fermin M. Atalig	Administrative Officer Office of the Resident Commissioner's Representative Rota, Mariana Islands District, TTPI
Dr. Bernard M. You	Director, Health Services Department Rota, Mariana Islands District, TTPI
Mr. Paul Q. Taisacan	Superintendent Division of Environmental Health Health Services Department Rota, Mariana Islands District, TTPI
Mr. Frederick W. Ayuyu	Assistant Sanitarian Division of Environmental Health Health Services Department Rota, Mariana Islands District, TTPI
CMDR David L. Burt, USN	CINCPAC Representative Guam, TTPI COMNAV, Marianas

### 3. THE MOSQUITO PROBLEM:

a. The study of mosquitoes has always been of special interest because of their relationship to disease transmission and effect on morale and economy. In the Marianas the principal mosquito-borne diseases have been dengue fever, filariasis of a rather benign type, Japanese B encephalitis, and malaria. Only dengue fever has been reported from Rota but the proximity of incidence of the other diseases indicates that introduction of a viable vector coincident with an infected individual or host could result in a local epidemic. There have been several recorded outbreaks of dengue fever in Micronesia with 3 cases reported from Rota as recently as 1935. An epidemic of dengue fever occurred on the neighboring islands of Tinian, Saipan and Guam during 1944. Infection with filariasis has been attributed to emigrants from Samoa and the Ryukyus. The latest reported case on Guam was in 1912. There was a major outbreak of Japanese encephalitis on Guam during November 1947 - January 1948, and two separate outbreaks of malaria occurred on Guam in 1966 and 1969.

b. The two most widely collected species during this survey were Aedes pandani and Aedes rotanus. These two mosquitoes are savage biters which have a distinct influence on morale and farming comfort and, if uncontrolled, will have considerable impact on the tourist business.

c. Philosophies on mosquito control.

(1) Mosquito control may be defined as that combination of efforts which eliminates noxious mosquito populations most effectively, practicably and economically, and with least effect on the environment and its human inhabitants. An effective program on Rota Island would include community awareness, area sanitation, garbage and refuse management, and quarantine measures. Due to the relatively heavy island-wide breeding and total vegetative cover, widespread use of chemicals for control is not recommended because of the expense of the pesticide, localized coverage and temporary persistence.

(2) Mosquito control is necessary for health, morale and national economy. It is imperative for an island community where the insect breeding potential is limitless and any change in the numbers or species of mosquitoes could affect the health or morale of the community or influence the economy directly.

(3) Mosquito control is a continuing program. Once started it must be continued; and it must be comprehensive and relentless if it is going to be effective.

### 4. MOSQUITOES ON ROTA:

a. According to the literature the mosquitoes of Guam and Saipan are relatively well known while Tinian has had one recent (1973) survey. Comparatively little, however, is known about the mosquitoes of the other Mariana Islands. The most comprehensive work on the mosquito fauna of the Marianas was compiled by Dr. Richard M. Bohart and published

in 1957. This book contains species and collection data from the earliest known surveys and records on the Marianas, and a copy is attached (Atch 1). A total of six species had been reported from Rota Island through 1975. All of them were collected initially by American military entomologists during post World War II surveys on Rota in 1945. The names of the species follow and the bionomic data for each are presented in Attachment 2.

Aedes (Stegomyia) aegypti Linnaeus  
Aedes (Stegomyia) guamensis Farner & Bohart  
Aedes (Stegomyia) rotanus Bohart & Ingram  
Culex (Culex) annulirostris marianae Bohart & Ingram  
Culex (Culex) litoralis Bohart  
Culex (Culex) quinquefasciatus Say

b. As in most tropical areas, the larvae of Mariana mosquitoes predominate in definitive containers, both natural and artificial, and occur in a variety of other habitats. Known or suspect breeding sources on Rota include:

(1) Natural

Pot holes	Stream pools
Tree holes	Temporary ground pools
Small rock holes	Perimeters of marshes
Hoof prints	Drainage runoff streams
Plant leaf axils	Cesspool overflow streams
	Irrigation ditches

(2) Artificial

Tin cans	Bottles, crocks and basins
Rubber tires	Coconut shells
Cisterns	Empty land snail shells
Fish ponds	Empty clam shells
	Partially empty 50-gallon drums

c. A definitive survey of all island environments for mosquitoes was accomplished by a two-man team on Rota during May 1976. The Island was divided into six zones plus Songsong Village, and one full day was devoted to sampling for the mosquito fauna in each zone. Collecting procedures included the physical examination of both natural habitats and artificial containers for immature forms; employment of portable light traps in heavily wooded areas, in stream beds, along beaches, adjacent to the central trash and garbage dump, and throughout Songsong Village; and resting/biting stations to collect species attracted to mammals. Particular survey attention was given to the four major areas of possible human contact on the island: the airport, the refuse dump, the primary beach areas, and Songsong Village. A map showing the points of collection is included with this report as Attachment 3.

d. The 1976 survey produced a total of seven species of mosquitoes; three were new collection records for Rota, and one of those is an

important vector of dengue fever elsewhere in the Marianas. The collection of Aedes guamensis, Aedes rotanus, Culex annulirostris marianae and Culex quinquefasciatus confirmed continued existence of those species captured during 1945. The absence of Aedes aegypti and Culex litoralis was expected. While Aedes aegypti was prominent during the early surveys on Guam and Saipan, the species declined rapidly following massive control programs during the late 1940s. Only a single specimen of this species was discovered on Guam during a 1950 survey, for example, and the species was not recovered again until the 1970s. Culex litoralis larvae are found commonly during the rainy season and they are not found at all during the dry season. The 1976 survey was conducted during a dry period. The new species collected here for the first time were Aedes albopictus, Aedes neopandani and Aedes pandani. Aedes neopandani has been recorded from Saipan and Tinian; Aedes pandani is common on Guam, and Aedes albopictus is common on both Guam and Saipan and has also been collected from Tinian. The adult of Aedes albopictus is a severe pest and it is considered to be an important vector of dengue fever. Bionomic data for these additional species are included in Attachment 2. Aedes rotanus was recovered in great numbers and from each of seven island collection zones. Only a few (3-17) adults in the other species were identified, and Culex annulirostris marianae was collected only in the larval form and at a single point along the precipitous southeastern coast. Aedes albopictus was collected on the southern coast bordering the bay; Aedes pandani and Aedes neopandani were found in the wooded areas on the northern plateau and along the southern coast with Aedes guamensis occurring along the beach areas on the northwest and steep southeast coasts. Culex quinquefasciatus was restricted to Songsong Village. The species distributions are shown in the map included as Attachment 4.

e. The significance of these 1976 collection data is twofold:

- (1) There is inter-island introduction of species to Rota.
- (2) A change has occurred in the medical potential on Rota.

Rota Island is serviced by two airlines, and a total of five flights per day land at the Rota Airport. Three of these flights originate at Guam, while the remaining two are return stops from Saipan. There were no aircraft disinsection procedures on the flights taken to and away from Rota by the author, and no mosquito control activities are conducted at the Rota Airport. It is inevitable that the constant daily flights from Guam and Saipan will provide repeated introductions of mosquitoes into Rota, and collection records on Guam, for instance, show that when this is continued without interruption there is an increase in species count. It would appear that Aedes neopandani has already been introduced from Saipan, that Aedes pandani has been introduced from Guam, and that Aedes albopictus could have come from either Guam or Saipan. This is classic evidence of local importation. The introduction of Aedes albopictus has brought an acknowledged vector of dengue fever to the island. This is potentially dangerous with the concentration of the island population in Songsong Village. The arrival of a single individual infected with the dengue fever virus could result in an epidemic of dengue on Rota.



## 5. MOSQUITO CONTROL PROBLEM AREAS AND RECOMMENDATIONS:

### ITEM 1: Mosquito quarantine (Rota Airport)

COMMENT: A quarantine program is imperative to preclude introduction of additional mosquitoes including new species, and to eliminate out-of-country transport of local species. The 1976 collection data show an increase in species number which can be attributed to the inter-island air transport. An effective quarantine program has two phases: (1) disinsection of the aircraft immediately prior to landing and immediately following takeoff; (2) surveillance and control of mosquito breeding at the airport.

#### RECOMMENDATIONS:

a. The Trust Territory Government require that all airlines servicing the Northern Mariana Islands conform to the aircraft disinsection procedures as outlined in the World Health Organization international quarantine regulations for aerial commerce (Atch 5).

b. The Division of Environmental Health, Health Services Department, Rota, assign one technician at the airport to provide quarantine services. This individual would meet each flight to confirm chemical disinsection prior to landing. He would also maintain surveillance over mosquito breeding areas in the airport area and provide control service; and he would capture both larval and adult mosquitoes in the airport area for identification and community significance.

### ITEM 2: Garbage and trash management.

COMMENT: The existing "Temporary Dump" is an open land dump. It breeds rats and mosquitoes and is insanitary. The coral substrate, volume of garbage and refuse, and need for an adequate facility within reach of Songsong Village make a sanitary landfill the most practicable solution for garbage and refuse disposal. There is no comprehensive garbage and refuse collection program either in Songsong Village or at the several public beaches, and it is not practicable to expect the citizenry to haul their own waste to a city dump. The island is littered with metal cans and other trash. The original dump on the "Wedding Cake" peninsula is unsightly. There is a requirement here for operation of a sanitary landfill and maintenance of a sanitary environment throughout the island.

#### RECOMMENDATIONS:

a. Establish a sanitary landfill at the existing "Temporary Dump" site. (See Landfill in Attachment 6).

b. The city establish a city-wide garbage and trash pickup program. Collection would be made at each home, or ten collection sites could be designated within Songsong Village.



b. Clear all brush from empty lots within Songsong Village and adjacent to homes.

c. Maintain daily surveillance with light traps and surveys.

ITEM 5: Permanent versus chemical control for mosquitoes.

COMMENT: The island of Rota is very heavily overgrown with trees and other vegetation. The mosquito populations were intense at each elevation sampled and in each of the zones surveyed, and it is assumed that the entire island is supporting breeding in the variety of ecologic niches listed in paragraph 4b, above. There are farms and ranches on the northern plateau and farms along the bay on the southern coast, but the majority of the people live in Songsong Village. It would not be practicable from any aspect to attempt an island-wide mosquito control program with chemicals. Chemical means are generally quicker, but they have localized use, are of temporary duration, and are expensive in that treatment must be repeated. There is also the environmental contamination consideration with dispersal of chemicals. However, localized chemical control is advised for elimination of breeding forms in sites which cannot be filled or drained; for relief from large populations of adults which have invaded beaches or the living areas; and for immediate control when the introduction of vectors or generation of large pest populations is suspected.

RECOMMENDATION: A pesticide applicable for mosquito control be used within Songsong Village and in those isolated areas such as the city dump, beach recreation areas and the airport when immediate control is desired of large adult mosquito populations, or vector populations, or breeding populations.

ITEM 6: Community awareness.

COMMENT: Mosquito control cannot be achieved in the face of public apathy, and education is both economic and an effective weapon. The community, in general, is not aware of the needs for mosquito control; the dangers of uncontrolled mosquito populations; the methods for effective mosquito control; and what it can do to assist in control of these potentially dangerous insects. There is a definite need for community awareness of the disease potential and economic impact associated with continued mosquito infestation on Rota Island.

RECOMMENDATION: Educate the public on the necessity and methods for effective mosquito control. The children can receive this information at school; the adults through newspaper articles and public announcements during sporting events and other community gatherings.

ITEM 7: Technical training and city support.

COMMENT: While there are international regulations and city laws that can be passed for insect control, the government of the local community has the responsibility for providing mosquito surveillance and control operations for the medical safety and economic security of the people.

This can only be provided with technical equipment, trained manpower, and political support. Community pest control is a dual responsibility which must be discharged by the Health Services Department and the City Engineering Department. Both are essential. Health Services has the responsibilities for maintaining surveillance of mosquito breeding and population development; monitoring airport quarantine procedures; and recommending mosquito control operations. Engineering has the responsibilities for collecting garbage and refuse; operating the sanitary landfill; and accomplishing those land management or environmental control operations required to eliminate water catchments and other breeding areas, as well as adult harborage. The 1976 survey showed an increase in the number of Island species. Identification capability and a reference collection for training are needed.

#### RECOMMENDATIONS:

a. The scope of responsibility of the Division of Environmental Health, Health Services Department, be broadened to include airport mosquito surveillance and quarantine, and general mosquito surveillance with insect and rodent control management at the city dump. It also be provided with the two additional spaces required. The revised manning for this Division would be:

- Supervisor, Division of Environmental Health
- Water treatment, sewage systems, and food service facility inspections technician
- Airport quarantine and mosquito surveillance technician
- Insect surveillance and vector identification technician

b. The Engineering Division's Roads and Grounds Section be tasked with the additional responsibilities for garbage and refuse collection on a scheduled basis within Songsong Village and at the public beach recreation areas, operation of a sanitary landfill at the city dump, and city insect and rodent control. It also be provided with the three additional spaces required. These would be:

- Sanitary landfill operation and city insect and rodent control technician
- Garbage and refuse collection (2 personnel)

c. The Trust Territory Government procure the following equipment items to support the expanded missions of the Environmental Health Division and the Engineering Department:

- 3 New Jersey type mosquito light traps (adult mosquito surveillance)
- 1 Dissecting microscope (identification of mosquitoes)
- 1 2-gallon back pack sprayer (localized chemical control of mosquito breeding sites)
- 1 Portable insecticide fogging machine (area vector/pest mosquito population control)
- 1 Dozer (sanitary landfill operation)

- 1 Truck (garbage and refuse collection)
- 1 Truck, pickup (water and sewage testing, mosquito surveillance, and local insect and rodent control)

d. Training arrangements be made by the Trust Territory Government with agencies on Saipan or Guam to qualify the technicians for the new positions in airport quarantine, sanitary landfill operation, mosquito surveillance, vector identification, and insect and rodent control.

e. The Division of Environmental Health develop and maintain a reference collection of the mosquito species collected on Rota. The nucleus for this collection will be furnished by the HQ 1st Medical Service Wing with specimens collected during the 1976 survey.

#### 6. COMMENTS:

a. The preparation of this report was delayed due to interruption by typhoons Olga, Pamela, Ruby and Therese; the time needed to complete the identifications of the more than 1,000 mosquitoes collected during the survey; and procurement of the publications being offered as guides to facilitate mosquito control activities on Rota.

b. Mosquito control is necessary for reasons of health, morale and economy. An effective mosquito control program can be developed on Rota; but once started each gain must be maintained, and the program must be continued until all breeding areas are controlled, the adult populations are negligible, and all possibilities of species reintroduction have been eliminated.

c. The Division of Environmental Health is invited to send all adult and larval specimens collected to the US Air Force for identification. Specimens should be packaged, labelled and addressed in accordance with instructions in the HQ 1st Medical Service Wing Publication, "Insect Packing and Shipping Protocols," (Atch 7). A form letter with the identifications will be mailed back. Specimens will not be returned unless this is requested in a letter accompanying the specimens.

d. The survey team would like to acknowledge the outstanding support it received throughout the study period. This included acceptance by the community, solicitude of the police, and assistance from the island Health Services. The overt and sincere interest shown by the Resident Commissioner's Representative and his Medical Officer-in-Charge were greatly appreciated. The authorization for use of the vehicle from the Office of the Resident Commissioner's Representative and the daily assistance provided by the personnel assigned to the Division of Environmental Health contributed substantially toward making possible the physical aspects of this survey and assuring total mission accomplishment with technical success.

## ATTACHMENTS

1. Insects of Micronesia, Diptera: Culicidae by R.M. Bohart
2. The Mosquito Fauna of Rota Island
3. Map: Mosquito Collection Points, Rota Island
4. Map: Mosquito Species Distribution, Rota Island
5. Vector Control in International Health, World Health Organization
6. Air Force Manual 91-16, Military Entomology Operational Handbook
7. HQ 1st Medical Service Wing Report, Insect Packing and Shipping Protocols
8. Air Force Manual 161-10, Field Hygiene and Sanitation

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* Office of the Surgeon, HQ Pacific Air Forces APO San Francisco 96553	2
* With Attachments 2, 3, and 4 only.	

## THE MOSQUITO FAUNA OF ROTA ISLAND

### 1. Aedes (Stegomyia) aegypti (Linnaeus)

Adults and larvae collected initially on Rota in 1945.  
Larvae are found most commonly in artificial containers.  
Adults are rarely found at any great distance away from human habitation.  
The adults are ready biters.  
Medical importance: Vector of dengue fever.

### 2. Aedes (Stegomyia) albopictus (Skuse)

Adults and larvae collected initially on Rota in May 1976.  
Larvae are most often found in artificial containers & in tree holes.  
The adults occur freely in wooded areas where they rest under leaves.  
The adults are severe day biters.  
Medical importance: This species is considered to be an important vector of dengue fever.

### 3. Aedes (Stegomyia) guamensis Farner & Bohart

Adults and larvae collected initially on Rota in 1945.  
Larvae occur in containers of various sizes, both natural & artificial.  
Adults are found in the deep jungle away from human habitation.  
Adults have never been observed in nature biting man.  
Medical importance: Because of its biting habits it is doubtful if this species is concerned with transmissions of human diseases.

### 4. Aedes (Stegomyia) neopandani Bohart

Adults only collected initially on Rota in May 1976.  
Larvae are known only from Pandanus and taro axils.  
The adults occur naturally in heavily wooded areas.  
The adults are severe biters.  
Medical importance: Pest species. No known disease association.

### 5. Aedes (Stegomyia) pandani stone

Adults only collected initially on Rota in May 1976.  
Larvae have been found only in leaf axils - commonly in those of Pandanus, occasionally in those of taro.  
This species is a severe pest in wooded areas.  
Adults bite readily during the day from dawn through dusk in sun and shade.  
Medical importance: Severe pest species. No known disease association.



6. Aedes (Stegomyia) rotanus Bohart & Ingram

Adults and larvae collected initially on Rota in 1945.

Larvae are found commonly in Pandanus leaf axils and less frequently in tree holes and artificial containers.

Adults occur in natural Pandanus jungle.

The adults are severe biters.

Medical importance: No known medical importance. Pest species.

7. Culex (Culex) annulirostris marianae Bohart & Ingram

Adults and larvae collected initially on Rota in 1945.

Larvae are collected in fresh or slightly brackish water of ground pools, concrete cisterns and artificial containers.

Adults are only rarely taken in habitations or found attracted to humans.

Adults have only rarely been associated with man in nature.

Medical importance: No known medical importance.

8. Culex (Culex) litoralis Bohart

Adults and larvae collected initially on Rota in 1945.

Larvae are found rather commonly during the rainy season in nearly fresh to saline water in coral rock holes and other containers along the coast. They are not found at all during the dry season.

The habits of the adults are not known.

Medical importance: Not known.

9. Culex (Culex) quinquefasciatus Say

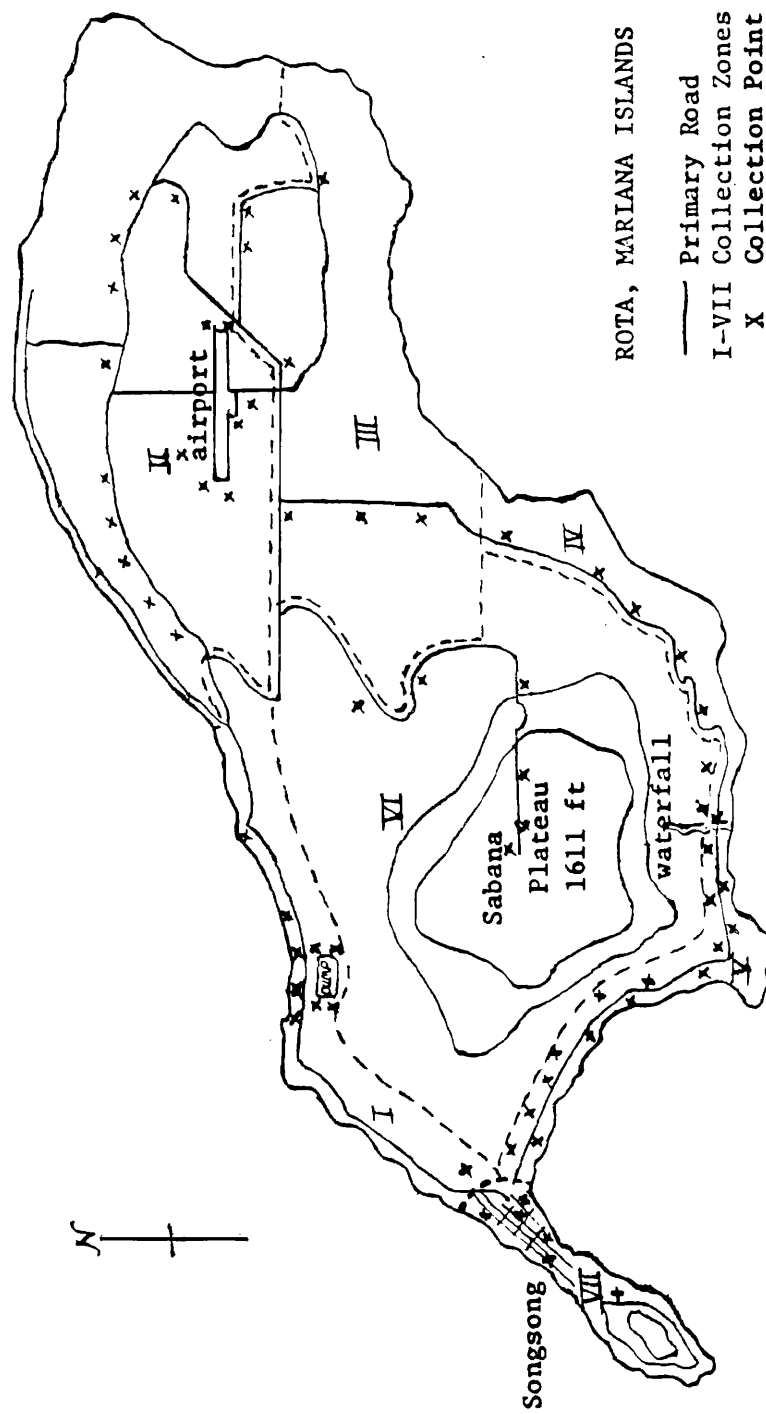
Very probably both adults and larvae of this species were taken during 1945.

Larvae are commonly found in artificial containers and ground pools.

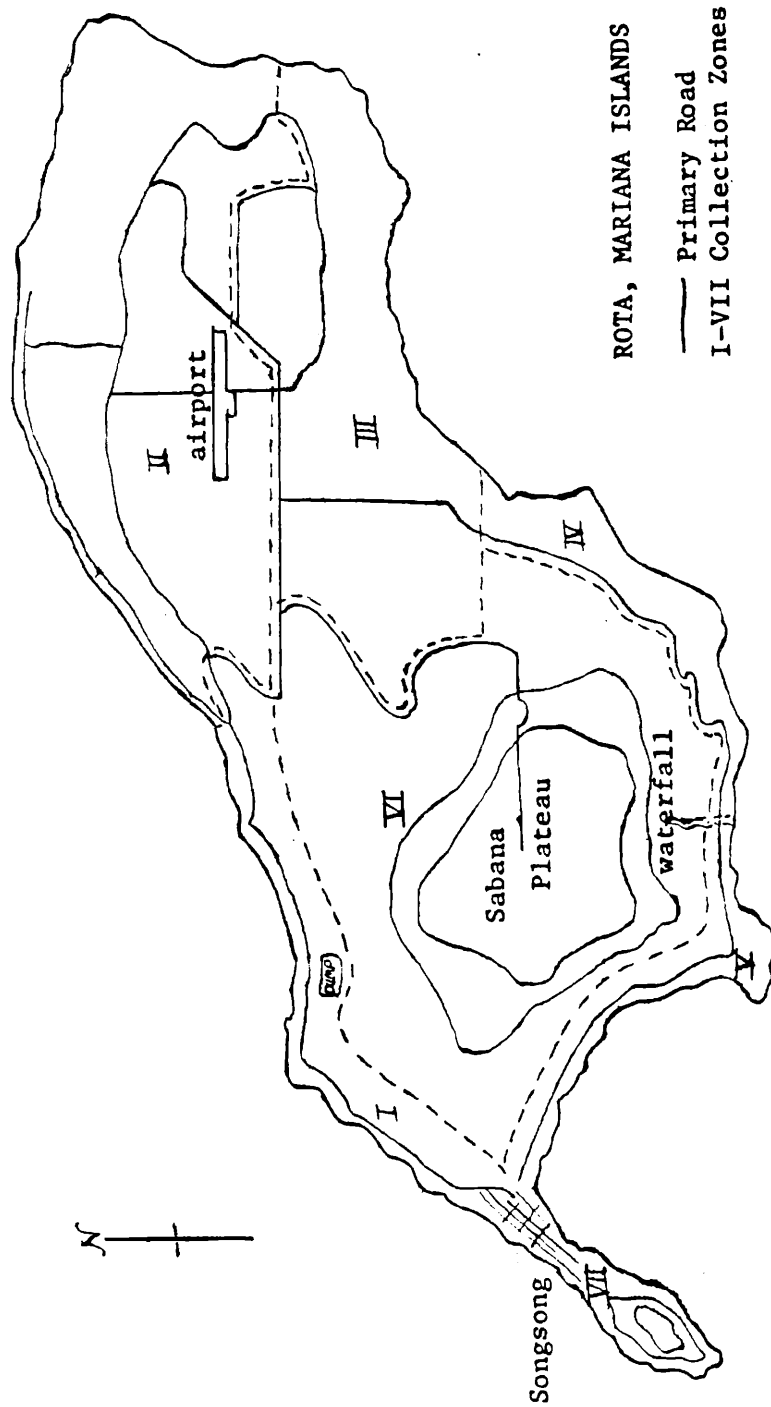
The adults are pests at night in human habitation areas.

The adults are severe biters.

Medical importance: Vectors of periodic filariasis and of Japanese B encephalitis.



MOSQUITO COLLECTION LOCATIONS, LARVAE AND ADULTS



<u>Aedes albopictus</u>	V, VII	<u>Culex annulirostris</u>	IV
<u>Aedes guamensis</u>	I, II, IV, V, VII	<u>marianae</u>	
<u>Aedes neopandani</u>	II, V	<u>Culex pipiens</u>	
<u>Aedes pandani</u>	II, III, V, VI, VII	<u>quinquefasciatus</u>	IV, VII
<u>Aedes rotanus</u>	I through VII		

MOSQUITO SPECIES DISTRIBUTION (BY ZONE)